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18 DEC 1952

MEMORANDUM FOR DEPUTY CHIEF OF STAFF, DEVELOPMENT

SUBJECT: Satellite Vehicles

1. There is a requirement for a satellite vehicle capable of orbiting the earth at oblique angles and transmitting terrestrial reconnaissance data from its orbital positions to stations on the surface of the earth.
2. It is anticipated that the Union of Soviet Socialist Republics may soon have the capability of launching an intercontinental H-bomb attack on the United States. Such an attack is unacceptable to the security of the United States. Thus all possible means must be taken to obtain reconnaissance and surveillance data leading to knowledge of Soviet capabilities and intentions before the beginning of hostilities. It is considered that complete and accurate surveillance will require . This must be accomplished without A small, fast, high-flying aircraft offering a difficult radar target may be one answer. The satellite will also offer a solution. Other valuable military developments are also expected to evolve from the satellite. It will be an important step to possible future weapon carrying satellites, missile guiding and observing stations and to further exploration and exploitation of high altitudes and outer space.
3. The requirement for a satellite does not stem from purely military considerations. Highly important political, psychological and scientific advantages are likewise to be gained from developing and launching the first satellite vehicle. The addition of novel unconventional facilities to the military system of this country is likely to be seen by others in terms of a change in the existing balance of strength and thus represents a political and psychological problem. The furtherance of knowledge on the upper regions of the atmosphere and of outer space provided by satellite vehicles would give our country a definite scientific advantage over competitors. The development and operational experience would also be important in this respect.
4. Assuming that success of this project is a function of only time, money, manpower and technological advances it is intuitively clear that time must not suffer from over-austerity concerning the other factors. An estimate of the time involved in the development and launching of a satellite as a function of the money and manpower expended would be

helpful in further establishing the degree of effect.

5. In formulating the military characteristics of the satellite vehicle, attention should be given to the possible inclusion of the following characteristics:

- a. Delayed transmission, enabling transmissions only in range of United States or friendly territory.
 - b. Capability of resolving 300 foot dimensions or better.
 - c. Flight duration and component reliability of at least 35 days.
6. Because of the unique military and political implications of such a vehicle the utmost security should be attached to its development and launching.

SGD: Thomas D. White

THOMAS D. WHITE
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Deputy Chief of Staff, Operations

THE PROBLEM

1. To summarize the status of satellite vehicles, examine their military applications and to recommend pertinent action.

FACTS BEARING ON THE PROBLEM

2. On 12 Jan 1948 Gen. Vandenberg signed a statement of policy for a satellite vehicle which reads as follows:

"The USAF, as the Service dealing primarily with air weapons - especially strategic - has logical responsibility for the Satellite.

Research and development will be pursued as rapidly as progress in the guided missiles are justified and requirement dictate. To this end the problem will be continually studied with a view to keeping an optimum design abreast of the art, to determine the military worth of the vehicle - considering its utility and probable cost - to insure development in critical components, if indicated, and to recommend initiation of the development phases of the project at the proper time."

3. Subsequently (17 Feb 1948) RAND was requested to establish a satellite project whose function will be to foster the development of components and techniques which will be required for the eventual successful construction and operation of a satellite vehicle. The objectives of this RAND project are as follows:

- a. Prepare a detailed specification for the optimum satellite vehicle in the light of present knowledge.

- b. Continually review and modify this specification that it may be kept abreast of advancements in the various technical fields concerned.

- c. Advise USAF, on request, at any time during the program, as to the requirements in time, manpower and money to construct and operate a satellite vehicle.

- d. Advise the USAF, on request or at appropriate intervals as to what useful purposes could be served by the construction and operation of a satellite vehicle.

3. Advise the USAF of the optimum time to begin actual construction of a complete satellite as opposed to component development.

4. On 7 March 1951 the ABC was informed of the Air Force interest in a satellite vehicle and of the possible requirement for a radioactive heat source to furnish power to operate the electric system of the vehicle. ABC was requested to undertake the development of such a heat engine (this development project may result in a small nuclear reactor rather than a radioactive heat engine). Other subcontractors include:

a. North American Aviation for a study on the Altitude Control system.

b. RCA for research on a Television Transmission and Presentation system.

c. Ohio University Research Foundation for a study on the accuracy of target location as affected by altitude and resolution errors.

d. Boston University for minor flight tests relative to television equipment.

e. KMB in Hollywood for television experiments.

f. Consultants on trajectory, atmosphere and altitude control and solar heating engines.

DISCUSSIONS

5. Since 1947 RAND has published several studies on the various subjects concerning the satellite vehicle program, including: proposed type specification, cost estimates, launching sites, communication and observation problems, power plant, structure and weight, stability and control, propellant systems, analysis of atmospheric properties to extreme altitudes, dynamics and heat transfer problems, flight mechanics, political and psychological problems, and utility for reconnaissance.

6. Investigations to date indicate that (a) the engineering of unmanned rocket vehicles of adequate performance for use as a satellite would require

but minor development beyond existing technology, (b) the payload would have to be small (not more than 2000 lbs) in early versions, restricted to instrumentation and communication equipment, hence warheads are not likely to be economically worth while for many years to come, (c) returning the vehicle to earth intact would be difficult and should not be attempted in the early versions.

7. As a result of the above findings the major emphasis has been along the lines of a reconnaissance vehicle as the first satellite. It has been found that the various components constituting a satellite vehicle to be utilized for reconnaissance have been shown to be individually feasible in various degrees. To combine the parts into a reliable operating whole will require considerable basic scientific and engineering effort. No radically new developments are indicated, rather a reconstitution of known theory and art in rocketry, electronics, engines and nuclear physics. It has been found that a two-stage rocket vehicle weighing about 74,000 lbs and carrying a 1000 lb payload of television, powerplant, and control equipment will be capable, at least, of conducting weather and pioneer terrestrial reconnaissance with a resolvable surface dimension of about 200 ft. The reliability of the electronic equipment will determine the useful time duration of the satellite. Periods of duration from a few days up to one year appear to be attainable. Should the operational television equipment be improved to a state now attained under laboratory conditions it is believed that minimum resolvable surface dimensions of the order of 100 ft. can be provided with continuous coverage over most of the USSR every day. At the expense of daily coverage these dimensions can probably be further reduced to values as low as 40 ft, complete coverage being attained after no more than one month's operation.

8. The major portion of the feasibility studies has been completed by RAND and sub-contracts let for studies and research on component parts. ARDC is expected to complete, early next year, a review of the prospects

and desirability of conducting a development program on the vehicle as a whole.

9. The addition of novel and unconventional facilities to the military system of a country is likely to be seen by other nations primarily in terms of a change in the existing balance of strength. It represents, in this sense, a political problem. A satellite opens up avenues of action lying in a new dimension and not as yet available to other nations. Great military, political, psychological and scientific advantages are to be had by the nation first to develop and launch a satellite vehicle. World reaction would likely be comparable to that from the first atomic explosion. Russia's scientific and technical potential in the field of missiles is believed to be such as to enable that country to be well advanced towards the realization of a satellite vehicle. It is intuitively clear that our present modest effort in this field may be dangerously insufficient in the race for the first satellite.

10. Within the Department of Defense the Army, Navy, and Air Forces are all conducting missile and rocket research which could culminate in developments leading to satellite vehicles. The Army is known to be actively interested in a satellite. The following is quoted from a manuscript on space travel of rockets prepared at the Army Artillery School, Fort Bliss:

"The value of a space station circling the earth would be incalculable to any nation. The satellite could be used as a platform for both celestial and terrestrial observation, a launching platform for guided missiles against a target anywhere on the earth, a meteorological station and numerous other uses. It has been predicted that the nation with the first space station circling the earth will have absolute control over all other nations. The project is worthy of our utmost scientific ability and industrial skill."

There are grounds for concern when it is considered that the Air Forces may lose initiative and leadership to other agencies for a development so closely associated with our medium and mission.

11. Inasmuch as there has been no operational requirement stated for the satellite vehicle the study and research effort to date has been very modest (\$200,000 in FY 52, \$400,000 in FY 53, \$300,000 in FY 54). There is no doubt that over a period of years this degree of effort may be required but it may be "too little and too late". It is considered that the establishment of an operational requirement and a statement of the urgency will give the necessary impetus to the program. Such action would be expected to accelerate any development program contemplated as a result of the current ARDG review.

CONCLUSIONS

12. Studies to date have indicated that it is feasible to develop and launch a satellite vehicle initially capable of conducting weather and terrestrial reconnaissance. The time required for completion of the development program will depend largely upon the manpower and money effort expended.

13. There would be great military, political, psychological and scientific advantages accorded the first nation to successfully launch a satellite vehicle.

14. The Air Force should take the lead in the development and launching of a satellite vehicle.

15. A requirement should be stated in order that the development program will be given the proper impetus.

RECOMMENDATION

16. It is recommended that:

- a. The above conclusions be noted.
- b. An Air Force requirement be stated for a satellite vehicle.

ACTION

17. A draft memorandum for DCS/D has been prepared for DCS/O signature stating a requirement for a satellite vehicle.